Things to Know, Understand and Do
For Chapter 7: Atomic Structure and Periodicity

By the end of Chapter 7, you should

Know how to…
Use the terms, *wavelength, frequency, node*
Use equation $c=\lambda\nu$, the relationship between wavelength(λ) and frequency (ν) of electromagnetic radiation and the speed of light (c)
Recognize the relative wavelength or frequency of various types of electromagnetic radiation.
Understand that the energy of a photon, a masseless particle of radiation, is propotional to its frequency ($E = h\nu$). This is an extension of Plank's idea that energy at the atomic level is quantized
Describe origin of light from excited atoms, its relationship to atomic structure and how Bohr's atomic model accounts for the emission line spectra of excited hydrogen **and** why it does not work in an atom with 2 or more electrons.
Understand that, in the Bohr model of the H atom, the electron can occupy only certain energy levels, each with an energy proportional to $1/n^2$ ($E=-Rhc/n^2$)
Describe experimental evidence for and concept of particle-wave duality.
Recognize significance of quantum mechanical model of atomic structure.
Define the four quantum numbers (***n, l, m_l,m_s***) and their relationship to atomic structure.
Describe the allowed energy states of the electron in an atom using the four quantum numbers (***n, l, m_l, m_s***)
Describe the shapes of the s, p, and d orbitals and identify the types and numbers of nodes each has
Classify substances as paramagnetic (attracted to a magnetic field; characterized by unpaired electron spin(s)) or diamagnetic (repelled by a magnetic field; characterized by all electrons being paired)
Write the electron configurations (full and shorthand) for atoms in their ground and excited states as well as monatomic ions.
Using the periodic table as a guide, write electron configurations and draw orbital energy diagrams, recognizing paired and unpaired electrons. Also be able to write the 4 quantum numbers for any electron in the orbital energy diagram and know how to correctly identify orbitals that are ***degenerate*** (have the same energy.)
Write the electron configurations for Cr and Cu (and other members of their families), exceptions in electron filling order.
Recognize the electrons are assigned to subshells of an atom in order of increasing subshell energy in many electron atoms. (the ns orbital fills before the (n-1)d orbital.)
When assigning electrons to atomic orbitals, apply the Aufbau principle, Hund's rule, and the Pauli exclusion principle.

Predict how properties of atoms - size/radius, ionization energy, electron affinity, and electronegativity- change on moving down a group or across a period of the periodic table. The general trends for these properties are as follows: • Atomic Radius (Size) decreases across a period from left to right and increases down a group. • Ionization Energy increases across a period from left to right and decreases down a group. • The electron affinity generally increases (becomes more negative) across a period from left to ring and decreases down a group, but this depends if the electron configuration of the atom before the electron is added is more or less stable than that of the resulting anion. • Electronegativity increases across a period from left to right and decreases down a group.
Explain all of the periodic trends and/or differences in these properties in a given group of atoms or ions using principles of atomic structure, and/or determine effective nuclear charge and attraction by nucleus to valence electrons. Z_{eff} depends on the number of protons, the number of shielding(core) electrons, number of valence electrons and one might need to write the electron configuration(s) and can be estimated by $Z_{eff} = Z$ - # shielding electrons.
understand…
Understand how an orbital for an electron in an atom corresponds to both the allowed energy of that electron.
Understand that the position of an electron is not known with certainty (Heisenberg Uncertainty Principle); only the probability of an electron being at a given point in space can be calculated (this is the orbital in which it may be located)
That the Pauli exclusion principle lends to the conclusion that no atomic orbital has be assigned more than two electrons and that the two electrons in an orbital must have opposite spins.
The role magnetism plays in determining and revealing atomic structure.
The effective nuclear charge (Z_{eff} or Z^*) and its role in determining atomic properties.
The fundamental physical properties (size/radius, ionization energy, electron affinity, and electronegativity) of the elements and their periodic trends (across a period and down a family.)
Recognize the role that ionization energy and electron affinity play in the chemistry of the elements.

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